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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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1. 10/1/00 2. 10/1/00 3. 10/1/00

4. 10/1/00 5. 10/1/00

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10/1/00

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EXAMINER

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ART UNIT	PAPER NUMBER
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1/16
DATE MAILED:

08/19/01

11

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

09/362,924

Applicant(s)

Chow et al.

Examiner

Allan W. Olsen

Art Unit

1746

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 July 1999.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-54 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 39 and 40 is/are allowed.
- 6) ☐ Claim(s) 1-37 and 41-54 is/are rejected.
- 7) ☒ Claim(s) 38 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4-681011 6) ☐ Other:

DETAILED ACTION

Election/Restrictions

On June 15, 2001 the examiner contacted Applicant's representative, Ashok Janah, regarding a restriction requirement. After further consideration, the examiner has elected to forego, and hereby withdraws, the restriction requirement. This action addresses all pending claims on their merit.

Claim Objections

Claims 6, 48 and 49 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claims, or amend the claims to place them in proper dependent form, or rewrite the claims in independent form.

Claim 6 recites "[a] method according to claim 1 wherein the treating of the chamber comprises cleaning the chamber." This is not further limiting of claim 1 because the preamble of claim 1 recites that residue is removed from the surface of the chamber which characterizes claim 1 as a chamber cleaning method.

Claim 48 recites "[a] method according to claim 47 wherein (b) comprises providing an energized gas comprising an etchant gas." This is not further limiting because claim 47 (b) establishes that the energized gas is an etching gas by reciting "providing an energized gas ... to etch through the layer".

Claim 49 recites "[a] method according to claim 47 wherein (c) comprises providing an energized gas comprising a cleaning gas." This is not further limiting

Art Unit: 1746

because claim 47(c) establishes the energized gas as a cleaning gas by the recitation "providing an energized gas ...to... remove etchant residue...".

Claim 37 is objected to because it recites the limitation "A method according to claim 35 wherein the energized gas comprising oxygen is provided in the chamber while the substrate is in the chamber". The examiner notes that steps (b) and (c) of claim 35 allow for an energized gas comprising oxygen. This could lead one to misread the claim 37 limitation by applying it to the incorrect step of claim 35. The examiner notes that a limitation requiring that the substrate remain in the chamber during the energized oxygen treatment is suggestive of the fact that removal of the substrate would be an option. Removal of the substrate from the chamber during step (b) is not an option because step (b) is a substrate treatment step. This fact, coupled with the similarity of wording in claim 37 and in step (c) of claim 35, makes it seem clear that claim 37 is directed to step (c) of claim 35. Having clarity on this point, making rejection based upon 35 U.S.C. 112, second paragraph, would be improper. Therefore, the examiner respectfully requests the formulation of alternative claim language. Such as, "The method of claim 35 wherein in step (c), the energized gas comprising oxygen is provided in the chamber while the substrate is in the chamber".

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 32-34, 36 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 32-34 recites the limitation "...etching gas...". There is insufficient antecedent basis for this term etching gas. The base claim has been amended such that the term etching gas has been changed to etchant gas.

Claim 34 recites the limitation "...wherein the volumetric flow ratio of etching gas to residue cleaning gas...". Sufficient antecedent basis for this limitation was lost upon entry of the preliminary amendment.

Claim 36 recites the limitation "A method according to claim 35 wherein the volumetric flow ratio of etching gas to residue cleaning gas is from about 1:1 to about 20:1." The antecedent basis for "residue cleaning gas" is provided in step (b) of claim 35. The examiner notes that step (c), while not using the phrase "residue cleaning gas", nevertheless, uses a gas to clean residue. Therefore, the "residue cleaning gas" limitation of claim 36 might be applied to both either step (b) or (c). One possible resolution is amending the claim to read "A method according to claim 35 wherein in step (b), the volumetric flow ratio of etching gas to residue cleaning gas is from about 1:1 to about 20:1."

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

Claims 1-6 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Japanese Patent Publication 01050427 (Hiroyuki).

Hiroyuki teaches a method of removing residue from a plasma chamber by exposing the chamber to two successive plasma treatments. The first plasma is generated with a mixture of CF₄ and O₂ and the second treatment is an O₂ plasma.

Claims 7-15, 17-26, 35-37, 51, 53 and 54 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,180,464 issued to Tatsumi et al. (hereinafter, Tatsumi).

Tatsumi describes a process of etching a multi-layered substrate comprising patterned mask which overlies a metal silicide layer which in turn is overlying a polysilicon layer which overlies an oxide layer which overlies a silicon base. Tatsumi teaches etching the polycide layer (i.e. the combined tungsten silicide and polysilicon layers) with HBr mixed with NF₃ or SF₆ in a 1:1 to 1:99 ratio. To this mixture He and/or O₂ may be added. Tatsumi teaches conducting an oxygen plasma treatment before the

Art Unit: 1746

last over-etching step which consist of using a plasma of either 100% SF₆ or 100% HBr. The overetch is carried out with a chamber pressure of 5 mTorr and a source power to bias power ratio of 8.5:1. See columns 7 and 8.

Applicant and Tatsumi etch the same material (polycide). The gases used by Tatsumi correspond to the claimed etching and cleaning gases. However, Tatsumi and applicant do not attach the same label or function to each particular gas. For example, both applicant and Tatsumi use SF₆ to etch a W/Si layer. Applicant claims SF₆ as a cleaning gas while Tatsumi makes no reference to a cleaning gas. Despite the fact that Tatsumi does not refer to SF₆ as a cleaning gas it is the examiner's position that the same gas being used in like processes would inherently function in the same capacity.

Claims 7-15, 17, 18 and 35-37 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 5,874,363 issued to Hoh et al. (hereinafter, Hoh).

Hoh teaches a method of etching a metal silicide with a plasma generated from HCl and Cl₂. In a first step, NF₃ (cleaning gas) is added to a gas mixture in an amount of up to 10%. Subsequently, the addition of NF₃ is stopped and, with the substrate remaining in the chamber, the etching is continued with O₂ being added to the gas mixture. This results in residues being removed from the chamber surfaces. The process conditions during this second stage of the process include a chamber pressure of between 2 and 8 mTorr and plasma source power of 150 - 300 W and a substrate bias power of 150 - 200 W. See column 3, line 23 - column 4, line 28.

Claims 7-15, 19-26, 35-37, 47-49 and 51 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,354,417 issued to Cheung et al. (hereinafter, Cheung).

Cheung teaches a multi-step plasma etching method. In a first step, a mixture of HBr, SF₆, and O₂ is used. In a second step, a mixture of HBr, Cl₂, He and O₂ is used. Cheung teaches that etching processes results in etching residue being deposited upon the surface of the chamber walls. However, with Cheung's method the amount of residue is reduced because the process gases remove the residue. Following the second step an oxygen plasma step is performed after which the substrate is removed from the chamber to undergo a wet etch/cleaning step.

There is not absolute correlation between the terminology in applicant's claims and in Cheung's disclosure. For example, Cheung does not describe the cleaning aspect of the oxygen plasma step. However, the examiner sees this step as being analogous to applicant's final cleaning step of the process set forth in Table 2 on page 22 of the specification. Even though Cheung does not attribute the cleaning function to the oxygen plasma step it is the examiner's position that the same gas being used in equivalent processes would inherently function in the same capacity. A comparison between applicant's enabling disclosure (Table 2 and related discussion) and the process of Cheung as set forth in example 14, column 8 and table III, shows that, within the context of the rejected claims, the two methods are the same. See: abstract; column 1, line 65 – column 2, line 23; Column 2, lines 59-64column 4, lines 1-10, 42-54; column 6, lines 1-32; column 8, line 12- column 9, line 27.

Claims 27-34 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,378,311 issued to Nagayama et al. (hereinafter, Nagayama).

Nagayama teaches a method of etching a substrate that is electrostatically held upon an electrode in a plasma chamber. Nagayama's method includes introducing a first energized gas comprising an etchant gas to etch the substrate and removing residual charge from the substrate while a second energized process gas is provided to remove etchant residue from surfaces in the chamber. See column 6, lines 39-43.

Example 6 of Nagayama (column 12) meets the limitations of instant claims 28, 29 and 32-34 by teaching a polycide etching process in which the first energized gas comprises SF_6 and HBr . With regard to the limitation of claim 34 pertaining to the volumetric flow ratio of an etching gas to a residue cleaning gas it is noted that Nagayama does not refer to SF_6 as a residue cleaning gas. However, Nakayama and applicant both use of a mixture of SF_6 / HBr as a first energized process gas to etch a polycide layer. Despite the fact that Nagayama and applicant assign different functions to the process gases it is the examiner's position that the same gases being used in equivalent processes would inherently function in the same capacity.

The limitations of instant claims 30 and 31 are taught by Nagayama's comparative example (column 8) in which O_2 is retained within the chamber as the substrate's residual charge is dissipated and the chamber is cleaned.

Claims 7-16, 18, 27-33 and 46-50 are rejected under 35 U.S.C. 102(b) as being anticipated by 0 709 877 A1 (hereinafter, Saito).

Saito teaches a method of using an energized gas to etch a layer on a substrate that is electrostatically held onto an electrode. Saito teaches etching a silicide with HBr. Following the etching step, and without removing the substrate from the reactor, O₂ is introduced to clean the chamber by etching away the deposits generated from the prior etching step. The O₂ cleaning step also serves to remove the residual charge from the substrate. See column 3, line 44 – column 4, line 16 and column 5, line 20 – column 6., line 16.

Claims 41 and 42 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 5,817,534 issued to Ye et al. (hereinafter, Ye).

Ye teaches a method of cleaning a reaction chamber that involves adjusting the power such that the residue deposition rate is equal to the rate at which the residue is etched away from the surface of the chamber wall. Ye teaches that when the residue etching rate lags behind that of the residue deposition rate, the power level of the plasma source should be increased so as to increase the rate of residue etching (i.e. chamber cleaning). See: column 2, lines 55-60; column 3, lines 3-8; column 6, lines 3-32; column 8, lines 44-50

Claims 7-12, 14, 15 and 51-54 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,164,330, issued to Davis et al. (hereinafter, Davis).

Claims 7-12, 14 and 15, 51, 53 and 54 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,164,330, issued to Davis et al. (hereinafter, Davis).

Davis teaches a multi-step process for etching a multi-layered substrate. Davis' selection of etching gases is such that the etching residue is cleaned from the chamber surfaces. In a first step a layer is etched with a plasma generated from a mixture of Ar (serving as the claimed etchant) and NF_3 (serving as claimed cleaning gas). The second step of Davis is carried out with a plasma generated from gas mixtures such as (NF_3 / Cl_2 / Ar) or (SF_6 / Cl_2 / Ar), where the Cl_2 serves as the claimed second cleaning gas which is different from the first cleaning gas. Davis teaches that the second step could also include gases such as CF_4 and O_2 . See: column 2, lines 36-37; column 3, line 35 – column 4, line 7; column 8, line 18 – column 9, line 55.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 41-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,620,615 issued to Keller in view of Ye.

Keller teaches a method of plasma cleaning reaction chamber that uses a mixture of $\text{NF}_3/\text{He-O}_2$ as the plasma source gas. Keller teaches that the exact same gases can be used to plasma etch tungsten and tungsten silicide layers. See column 1, line 55 – column 2, line 42.

Keller does not teach increasing the plasma power source in order to increase the amount of residue removed from the chamber walls.

Ye teaches a method in which the same process gases are used for etching and cleaning such that the etching a substrate and the cleaning the chamber walls can occur simultaneously. Ye teaches adjusting the power (e.g. increasing the power) so as to strike a balance between the amount of etching residue that is being simultaneously deposited and removed. See column 3, lines 3-8, column 5, line 17 – column 6, line 46.

It would have been obvious to one skilled in the art to apply the method of Ye to the etching process of Keller for the following reasons. Keller teaches methods of etching and cleaning, each of which use the very same gases. Ye teaches a method, that involves increasing the plasma source power so that the same process gases can be used to simultaneously etch a substrate and clean the etching chamber. The simultaneous etching and cleaning of an etching chamber significantly enhances the efficiency of the manufacturing process as the alternative independent chamber cleaning methods represent a substantial amount of down time for the etching apparatus.

Allowable Subject Matter

Claim 38 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 39 and 40 are allowed.

The following is a statement of reasons for the indication of allowable subject matter: Claim 38-40 require etching a substrate with at least one of Cl_2 , N_2 , O_2 , HBr and He-O_2 mixed with at least one of CF_4 , NF_3 and SF_6 and subsequently conducting an oxygen plasma treatment that both cleans the process chamber and assists in dechucking the wafer by dissipating the residual charge on the wafer. The examiner found no one reference teaching this combination of limitations nor any motivation to justify a combination of references to arrive at applicant's invention.

Conclusion

After completion of this action, the examiner received a supplemental IDS (paper #11). The IDS listed a PCT search report and the references cited therein all of which were identified as X type references. However, given the priority date of the instant invention, only Lowenstein (5,741,396), Keller (5,651,856) and Chen (EP 0200951) constitute prior art. The examiner agrees with the International Searching Authority that these references may be applied against some of the instant claims. However, given the rejections presented above the examiner does not believe it necessary to apply these references at this time.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allan Olsen whose telephone number is (703) 306-9075. The examiner can normally be reached on Monday through Friday from 9:30 to 6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Randy Gulakowski, can be reached on (703) 308-4333. The fax phone number for this Group is (703) 305-7719.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0661.

Allan Olsen, Ph.D.
July 31, 2001

Allan Olsen
PATENT EXAMINER
Art 1746